

# Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II

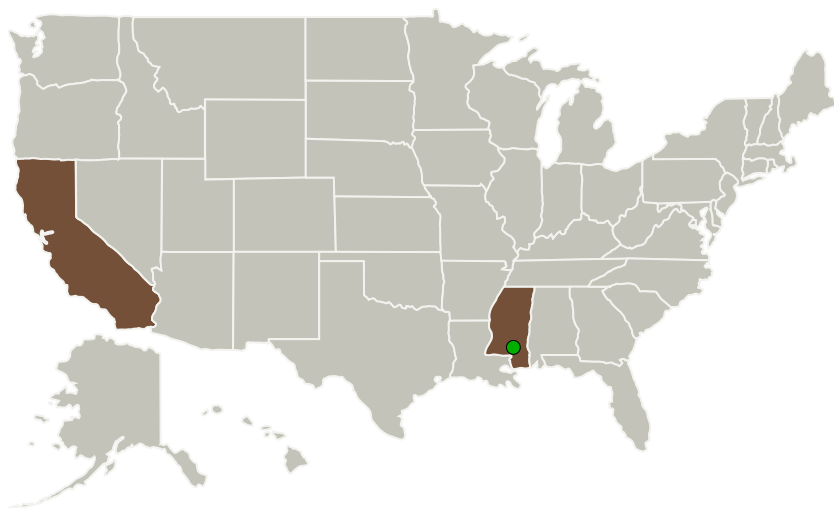
Completed Technology Project (2015 - 2018)



## Project Introduction

Efficient nuclear-thermal propulsion (NTP) requires heating a low molecular weight gas, typically hydrogen, to high temperature and expelling it through a nozzle. The higher the temperature and pressure, the higher the thrust and specific impulse. For ground test facilities that will be heating the gas to temperatures up to 4400F (2425C), the number of materials that can be used is severely limited. The need for compatibility with hot hydrogen limits the field even further. In Phase I, Ultramet designed, fabricated, and tested a system for heating high-pressure hydrogen to temperatures approaching 2400C. The system included a foam-based heating element, an insulation package, and a carefully designed multiwalled pressure vessel that could contain the hot gas at pressures up to 2000 psig. The Phase I effort demonstrated the suitability of the selected materials and the overall design approach. Phase II will focus on scaling up the system, fabricating and testing hardware, and laying out a clear path to a system that can deliver hot hydrogen at flow rates up to 40 lbm/sec (the highest flow rate currently of interest to NASA) at pressures up to 2000 psig. The overall system will be composed of multiple modules, and each module will be comprised of multiple heating elements. Because the design is modular, flows higher than 40 lbm/sec can be achieved. The modular design also minimizes programmatic risk because it will allow the use of materials at higher technology readiness levels and subsystems that do not have to be scaled up.

## Primary U.S. Work Locations and Key Partners



Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II

## Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

# Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II

Completed Technology Project (2015 - 2018)



Organizations Performing Work	Role	Type	Location
Ultramet	Lead Organization	Industry	Pacoima, California
● Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Primary U.S. Work Locations	
California	Mississippi

## Project Transitions

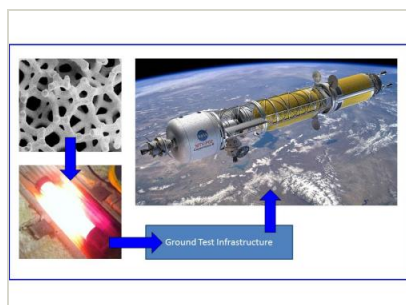
▶ **May 2015:** Project Start

✓ **August 2018:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/138149>)

## Images



### Briefing Chart

Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II Briefing Chart (<https://techport.nasa.gov/image/134816>)



### Final Summary Chart Image

Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II (<https://techport.nasa.gov/image/127593>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Ultramet

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

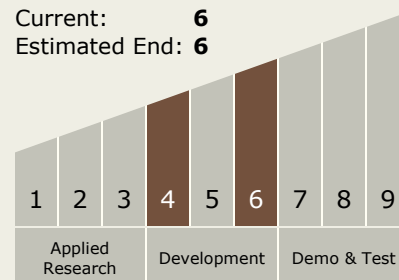
Carlos Torrez

### Principal Investigator:

Arthur J Fortini

## Technology Maturity (TRL)

Start: 4  
Current: 6  
Estimated End: 6



# Fabrication and Testing of Nuclear-Thermal Propulsion Ground Test Hardware, Phase II

Completed Technology Project (2015 - 2018)



## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.4 Advanced Propulsion
    - └ TX01.4.3 Nuclear Thermal Propulsion

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System